PATENT ABSTRACTS OF JAPAN

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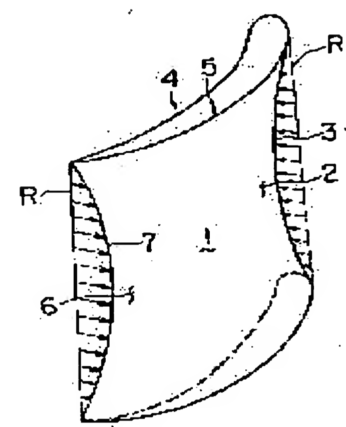
(54) HIGH PERFORMANCE BLADE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a high performance blade to further improve efficiency through reduction of winding up of a secondary flow, in a high performance blade used as the moving blades or the stationary blades of a steam turbine and a gas turbine.
SOLUTION: The shape in the direction of the height of a blade of a blade inlet part 2 is formed such that the central part of the height of the blade is protruded toward the belly 4 side of a blade 1, and formed in a curved shape forming a bow shape in a radial direction. Further, the shape, in the direction of the height of a blade, of a blade outlet part 6 is formed such that the central part, in the direction of the height of a blade, of the blade is formed in a curve shape, forming a bow shape, protruding toward the back side 5 of the blade 1 to form a blade profile. This constitution generates a flow, running toward a tip wall surface and a base wall surface, at the blade inlet part 2, pressurizes each wall surface, suppresses development of a vortex due to a secondary flow and reduces incurring of a secondary flow loss, and suppresses a pressure gradient in the direction of the height of the blade, occurring at the blade inlet port part 2, at the blade outlet port part 6, reduces the occurrence of winding up of a secondary flow due to a pressure gradient, reduces incurring of a flow loss due to a secondary flow, and improves the efficiency of a turbine.



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CLAIMS

[Claim(s)]
[Claim 1] The high performance aerofoil characterized by forming the aerofoil outlet section in the curve configuration of the arc shape which made the center section project to a backside in aerofoil height while the aerofoil inlet-port section is formed in the curve configuration of the arc shape which made the center section project to a venter in aerofoil height in the bucket of a steam turbine or a gas turbine, and the high performance aerofoil used as a stationary blade.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In order that this invention may control the secondary flow which generates a side-attachment-wall side [which was arranged near the aerofoil which operates in the flow of a uniform flow], and surface-area top in the progressing boundary layer, may reduce secondary flow loss and may raise internal efficiency, it uses as the three-dimensions aerofoil which changed the configuration in three dimensions, and relates to buckets, such as a steam turbine or a gas turbine, and the high-performance aerofoil which reaches or was used as a stationary blade.
[0002]
[Description of the Prior Art] With the high performance reactionary aerofoils, reduction of secondary flow loss according to a three-dimensions design method in a bucket and a stationary blade is achieved by reaction control. However, in manufacture by the three-dimensions design method of the conventional aerofoil, in respect of the side attachment wall which approaches the chip and the base of an outer-diameter edge among aerofoils, the secondary flow generated the side-attachment-wall side top in the progressing boundary layer, and this flowed out of the trailing edge of an aerofoil as an eddy, and had generated secondary flow loss. However, by leaning the configuration of the height direction of an aerofoil from a radial line, flow is forced on a side-attachment-wall side, development of the eddy in the side-attachment-wall side close to a chip and the base is pressed down, the eddy which flows out of the trailing edge of an aerofoil is reduced, and the thing aiming at reduction of secondary flow loss has recently been put in practical use. Thus, the high performance aerofoil which made the configuration of the height direction of an aerofoil incline from a radial direction is usually called the perfect three-dimensions aerofoil.
[0003] Drawing 3 is drawing which looked at the high performance aerofoil which was mentioned above, and which was manufactured by the conventional three-dimensions design method from the method Kogo style side of a shaft, and is the conceptual diagram showing the flow 05 and 06 which flows out of the inside of an aerofoil 01 with the configuration of a trailing edge 02. With the high performance aerofoils which are shown in drawing and which formed the aerofoil 01 by which the direction was formed in radial direction R in the shape of another straight line in aerofoil height so that he could understand from the configuration of a trailing edge 02 By manufacture of aerofoil 01 configuration by the three-dimensions design method, generate a surface-area top in the progressing boundary layer. Although reduction of loss by a secondary flow etc. can be aimed at, produce the chip wall surface [which counters an outer-diameter edge among aerofoils 01, and is arranged] 03, and base wall surface 04 top with the flow in the progressing boundary layer. The secondary flow loss which cannot reduce generating of a secondary flow, but produces by the secondary flow, and is produced by flowing out of a trailing edge 02 as an eddy was not able to be reduced.
[0004] A high performance aerofoil in drawing seen from the method Kogo style side of a shaft For this reason, the configuration of trailing-edge 02', As shown in drawing 6 which is the perspective view of drawing 5 which is the perspective view of the high performance aerofoil shown in drawing

4 which shows the flow 05 and 011 which flows out of the inside of aerofoil 01', and drawing 4 , and the high performance aerofoil arranged between the chip wall surface 03 and the base wall surface 04 A direction receives radial direction R in aerofoil height. In respect of [about 04] a chip 03 and the base While making the configuration of a direction incline mutually in aerofoil height in an opposite direction, the high performance aerofoil called a perfect three-dimensions aerofoil in which the curve of the arc shape which followed the direction in aerofoil height was formed is manufactured and used increasingly.

[0005] Moreover, this kind of high performance aerofoil may also be called a SUKYUDO (Skewed) aerofoil or a bow (Bow) aerofoil. Furthermore, with such perfect three-dimensions aerofoils, as shown in drawing 5 and drawing 6 , to radial direction R, the curve of the arc shape prepared in the aerofoil 02 height direction makes the center section of the direction the amount of the maximum protrusions in aerofoil height also with the aerofoil inlet-port section 07 near the first transition, and the aerofoil outlet section 08 near trailing-edge 02', and it is formed so that it may be made to curve to a **** 09 side. That is, as shown in drawing 5 , while applying only the amount shown in a direction by view die length in aerofoil height from first transition to trailing-edge 02' and incurvating it to a venter 010 to radial direction R, he is trying to form a bond segment for between the tip side to which the tilt angle to radial direction R becomes reverse mutually, and base sides by the smooth curve.

[0006] Since the center section of aerofoil height is incurvated to the venter 09 at the arc shape, with such conventional perfect Miyoshi aerofoils to the chip wall surface 03 and about 04 base wall surface backside 010 The other forcing flow 011 occurs, respectively on these wall surfaces 03 and 04 as shown in drawing 4 by the view. Reduction of secondary flow loss can be aimed at by reducing the cross flow which the pressure on the chip wall surface 03 and the base wall surface 04 is raised, and progresses on these wall surfaces 03 and 04 and which is generated in a boundary layer.

[0007] However, the thing for which the chip wall surface 03 and about 04 base wall surface pressure is raised in this way A pressure gradient will arise from these 03 or about 04 wall surfaces to direction and so-called radial direction R in aerofoil height. By this pressure gradient The flow of the mainstream 05 to radial direction R of a secondary flow generated in the boundary layer of these wall surfaces 03 and 04 which it will wind, a riser will increase, and this secondary flow winds, and passes through the inside of aerofoil 01' by the riser is disturbed, flow loss is enlarged, and there is fault that paragraph effectiveness falls.

[0008]

[Problem(s) to be Solved by the Invention] This invention raises the pressure the conventional high performance aerofoil especially a chip wall surface, and near the base wall surface. The property of the conventional perfect three-dimensions aerofoil of reducing the cross flow generated within the boundary layer which progresses on these wall surfaces, and having reduced secondary flow loss While making it maintain then, in order for the secondary flow which is generated with the conventional perfect three-dimensions aerofoils and which is generated by the pressure gradient formed in a direction in aerofoil height from on a chip wall surface and a base wall surface to wind and to prevent decline in the effectiveness by the riser, Let it be a technical problem to offer the high performance aerofoil which lessened decline in paragraph effectiveness by controlling the magnitude of the pressure gradient formed towards a center section in the aerofoil outlet section in aerofoil height from this chip wall surface and a base wall, and a secondary flow's winding, and reducing a riser.

[0009]

[Means for Solving the Problem] For this reason, the high performance aerofoil of this invention was made into the following means. The chip wall surface arranged by the three-dimensions design method near the chip of the aerofoil which operates in the flow of a uniform flow, And it sets on the high performance aerofoils which the pressure near [which was arranged near the base of an aerofoil] the base wall surface is raised, are made to reduce the cross flow in the boundary layer which progresses on these wall surfaces, and reduced secondary flow loss and which were manufactured by the perfect three-dimensions aerofoil. While the aerofoil inlet-port section incurvated the venter to the arc shape in the center section in aerofoil height, the aerofoil outlet

section made the aerofoil profile the shape of a profile which incurvated the backside to the arc shape in the center section in aerofoil height conversely.

[0010] With an above-mentioned means, the high performance aerofoil of this invention can reduce the secondary flow in a boundary layer [in / like the conventional perfect three-dimensions aerofoil / by the curve of the arc shape to the venter of the aerofoil inlet-port section / the chip and base wall surface and surface area of the outer-diameter edge in an aerofoil], can press down development of the eddy generated from these fields, can reduce the strength of the eddy which flows out of the trailing edge of an aerofoil, and can reduce secondary flow loss.

[0011] Moreover, from in addition, the thing carried out to the curve of the arc shape in which the aerofoil outlet section projects to a backside contrary to the curve of the arc shape of the aerofoil inlet-port section Forced flow on the wall surface side in the aerofoil inlet-port section, and the pressure drop had arisen from the chip wall surface and the base wall surface towards the center section in aerofoil height. The pressure gradient of a radial direction is missing from the aerofoil outlet section from the aerofoil inlet-port section, and becomes small gradually. It will wind, a riser will be reduced, secondary flow loss will be reduced, the mainstream turbulence which passes through the inside of the radial aerofoil of the secondary flow on the tooth back of an aerofoil generated with the conventional perfect three-dimensions aerofoils can decrease, and paragraph effectiveness can be raised.

[0012]

[Embodiment of the Invention] Hereafter, one gestalt of operation of the high performance aerofoil of this invention is explained based on a drawing. Drawing 1 is drawing showing the 1st gestalt of operation of the high performance aerofoil of this invention, and a perspective view to show the curve configuration of an arc shape prepared in a direction in aerofoil height and drawing 2 are perspective views to show what has arranged the high performance aerofoil shown in drawing 1 between a chip wall surface and a base wall surface.

[0013] As shown in drawing 1 , in the aerofoil inlet-port section 2 of an aerofoil 1, from the tip side and base side, the amount of protrusions by the side of an antinode 4 is enlarged gradually, and the configuration which curved to the arc shape of the shape of a curve made to project most to an antinode 4 side in the center section in aerofoil height is formed in the direction in aerofoil height. Namely, in the first transition 3 which is the maximum upstream edge of the aerofoil inlet-port section 2, the curve of the arc shape which projected only the magnitude shown by the die length of a view is formed in the antinode 4 direction shown by the view from radial direction R.

[0014] Moreover, in the aerofoil outlet section 6 of an aerofoil 1, it projects from a tip side and base side to a backside 5 gradually, an amount is enlarged, and the curve of the arc shape of the shape of a curve which becomes the amount of the maximum protrusions in the center section in aerofoil height is formed. Namely, in the trailing edge 7 which is the lowest style edge of the aerofoil outlet section 6, the curve of the arc shape which made only the magnitude shown by the die length of a view project is formed in the backside 5 direction shown by the view from radial direction R. Moreover, it is made the ** kana curve which does not have a break point even if it turns to the aerofoil outlet section 6 from the aerofoil inlet-port section 2, and the curve of the arc shape prepared in a direction in these aerofoil heights is *************.

[0015] Since the high performance aerofoil of this invention is constituted as mentioned above, it is set in the aerofoil inlet-port section 2 with the deflection of the arc shape prepared in the radial direction of the aerofoil inlet-port section 2. On the chip wall surface 8 prepared in the tip side of the aerofoil 1 shown in drawing 2 , and the base wall surface 9 prepared in the base side of an aerofoil 1, the other side, The forcing flow 011 shown in drawing 4 and the same flow occur, and the pressure on the chip wall surface 8 and the base wall surface 9 is raised. The secondary flow in these wall surfaces 8 and the boundary layer which progresses on nine is reduced by these pressure buildups, development of the eddy generated from each of wall surfaces 8 and 9 can be pressed down, the strength of the eddy which flows out of the trailing edge 7 of an aerofoil 1 can be reduced, and secondary flow loss can be reduced like the conventional perfect Miyoshi aerofoil.

[0016] From the aerofoil outlet section 6 having made it the curve of the arc shape formed in the aerofoil inlet-port section 2, and the curve of the reverse arc shape which formed the convex in

the backside 5, moreover, in the aerofoil inlet-port section 2 Force flow on the chip wall surface 8 and base wall surface 9 side, and a pressure drop arises from the chip wall surface 8 and the base wall surface 9 towards a center section in aerofoil height. It becomes small gradually by change of the configuration of the segment applied to the aerofoil outlet section 6 from the aerofoil inlet-port section 2 where the pressure gradient of a radial direction changes from the configuration of the segment projected to the venter 4 to the configuration of the segment projected to the backside, and ****** becomes is not less in the aerofoil outlet section 6. By disappearance of the pressure gradient reduced towards a center section in aerofoil height from on this chip wall surface 8 and the base wall surface 9, the turbulence of the rectification which would wind, and would reduce the riser, and secondary flow loss will reduce, and had been generated with the conventional perfect three-dimensions aerofoils and which passes through the inside of the radial aerofoil of the secondary flow in aerofoil 1 tooth back generated with the conventional perfect three-dimensions aerofoils can decrease, and paragraph effectiveness can be raised.

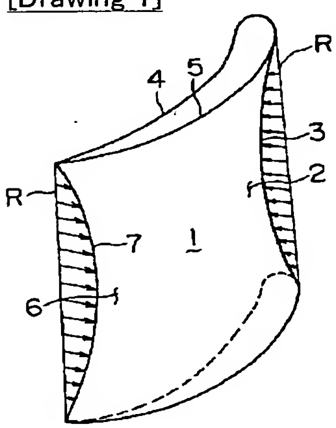
[0017]

[Effect of the Invention] As explained above, by the configuration which is shown in a claim according to the high performance aerofoil which becomes this invention It compares with the perfect three-dimensions aerofoil which has improved the high performance aerofoil manufactured by the conventional three-dimensions design method. From on a chip wall surface and a base wall surface, generating of the pressure gradient which changes to a direction in aerofoil height, respectively is controlled, the flow loss to radial [accompanying it / of a secondary flow] which it wound, and the riser was also controlled and originated in this secondary flow is reduced sharply, and a turbine efficiency can be raised.

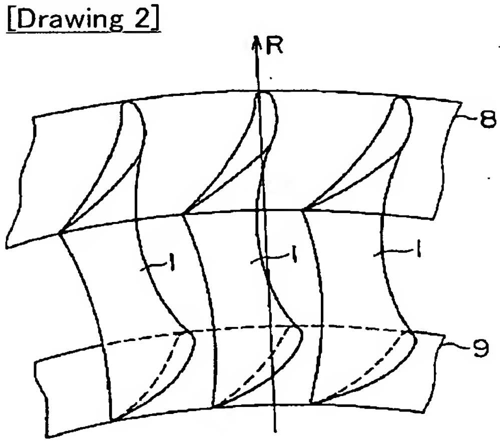
[Translation done.]

DRAWINGS

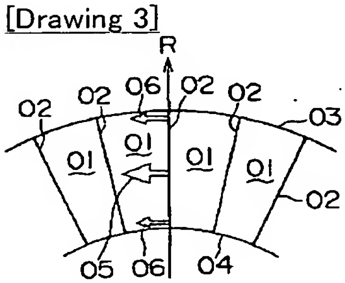
[Drawing 1]



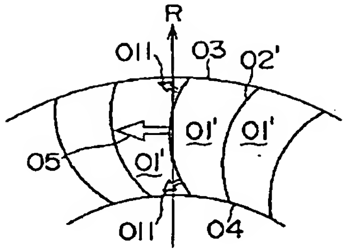
[Drawing 2]



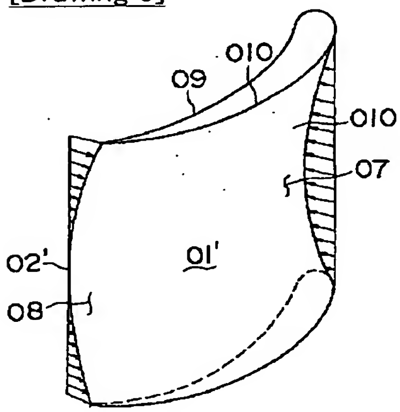
[Drawing 3]



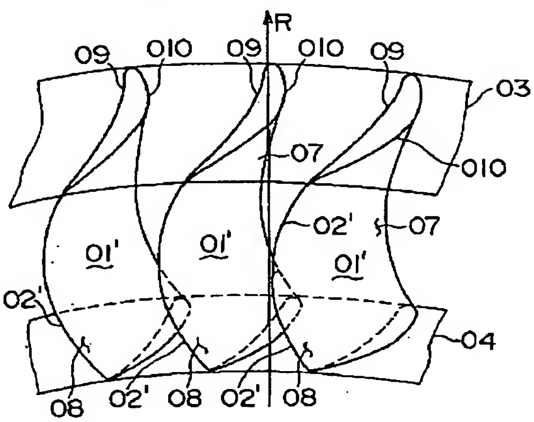
[Drawing 4]



[Drawing 5]



[Drawing 6]



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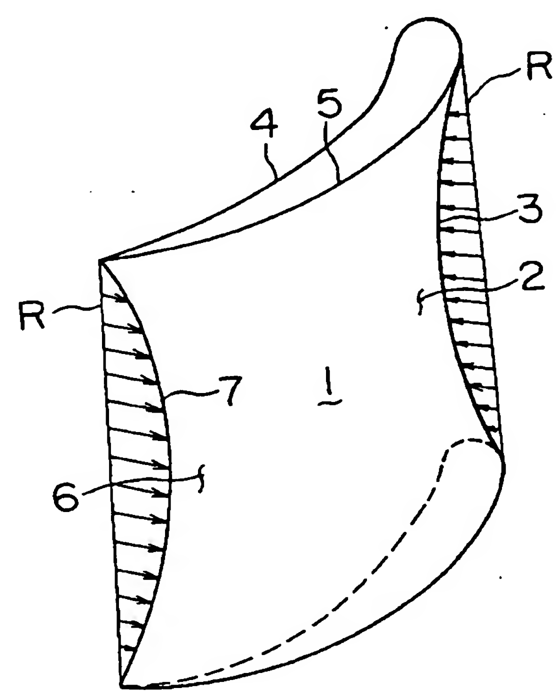
(54)【発明の名称】　高性能翼

(57)【要約】　（修正有）

【課題】　蒸気タービン、ガスタービン等の動翼や静翼として使用する高性能翼に関し、二次流れの巻き上がりを低減して、より効率を向上させることのできる高性能翼を提供する。

【解決手段】　翼入口部2の翼高さ方向の形状を、翼高さ中央部が翼1の腹4側に突出した、ラジアル方向に対して弓形になった湾曲形状にするとともに、翼出口部6の翼高さ方向の形状を、翼高さ中央部が翼1の背側5に突出した弓形の湾曲形状にした翼プロフィルとした。これにより、翼入口部2では、チップ壁面8およびベース壁面9に向う流れが生じ、各壁面8，9が加圧され、二次流れに起因する渦の発達が抑制され、二次流れ損失が低減するとともに、翼出口部6では、翼入口部2で発生する翼高さ方向の圧力勾配が抑制され、圧力勾配に起因する二次流れの巻き上がりを低減して、二次流れに起因した流動損失を低減し、タービン効率を向上させることができる。



【特許請求の範囲】
【請求項1】　蒸気タービン、若しくはガスタービンの動翼、および静翼として使用される高性能翼において、翼入口部が、翼高さ中央部を腹側に突出させた弓状の湾曲形状に形成されるとともに、翼出口部が、翼高さ中央部を背側に突出させた弓状の湾曲形状に形成されていることを特徴とする高性能翼。
【発明の詳細な説明】
【0001】
【発明の属する技術分野】本発明は、一様流の流れの中で作動する翼の近傍に配設された側壁面上、および翼面上を発達する境界層内に発生する二次流れを制御して、二次流れ損失を低減して、内部効率を向上させるため、三次元的に形状を変えた三次元翼にし、蒸気タービン、若しくはガスタービン等の動翼、および又は静翼として使用するようにした高性能翼に関する。
【0002】
【従来の技術】高性能反動翼では、リアクションコントロールによって、動翼、静翼共に、三次元設計法による二次流れ損失の低減が図られている。しかし、従来の翼の三次元設計法による製作では、翼の内、外径端のチップおよびベースに近接する側壁面では、側壁面上を発達する境界層内に二次流れが発生し、これが翼の後縁から渦として流出し、二次流れ損失を発生させるものとなっていた。しかしながら、最近になって、翼の高さ方向の形状をラジアルラインから傾けることにより、流れを側壁面に押しつけ、チップおよびベースに近接した側壁面における渦の発達を押さえて、翼の後縁から流出する渦を低減して、二次流れ損失の低減を図るようにしたものが実用化されてきている。このように、翼の高さ方向の形状をラジアル方向から傾斜させた高性能翼を、通常完全三次元翼と称している。
【0003】図3は、前述した、従来の三次元設計法に製作された高性能翼を軸方向後流側から見た図で、翼後縁02の形状と、翼01内から流出する流れ05，06を示す概念図である。図に示す、翼後縁02の形状から理解できるように、翼高さ方向が、ラジアル方向Rに向う直線状に形成された翼01を設けるようにした高性能翼では、三次元設計法による翼01形状の製作により、翼面上を発達する境界層内に発生する、二次流れ等による損失の低減は図れるものの、翼01の内、外径端に対向して配置されるチップ壁面03、およびベース壁面04上を発達する境界層内の流れに生じる、二次流れの発生は低減できず、二次流れによって生じ、翼後縁02から渦として流出することにより生じる二次流れ損失を低減することはできなかった。
【0004】このため、高性能翼を軸方向後流側から見た図で、翼後縁02′の形状と、翼01′内から流出する流れ05，011を示す図4、図4に示す高性能翼の斜視図である図5、およびチップ壁面03とベース壁面04との間に配列された高性能翼の斜視図である図6に示すように、翼高さ方向が、ラジアル方向Rに対してチップ面03およびベース面04近傍で、翼高さ方向の形状を相互に反対方向に傾斜させるとともに、翼高さ方向に連続した弓状の曲線を形成するようにした、完全三次元翼と称する高性能翼が製作され、使用されるようになってきている。
【0005】また、この種の高性能翼は、スキュード（Ｓｋｅｗｅｄ）翼、又はバウ（Ｂｏｗ）翼とも呼ばれることもある。さらに、このような完全三次元翼では、図5，図6に示すように、ラジアル方向Rに対して、翼02高さ方向に設ける弓状の湾曲は、前縁近傍の翼入口部07および後縁02′近傍の翼出口部08とも、翼高さ方向の中央部を最大突出量にして、翼腹09側に湾曲させるように形成されている。すなわち、図5に示すように、ラジアル方向Rに対して、翼高さ方向に矢視長さで示される量だけ、前縁から後縁02′にかけて腹側010へ湾曲させるとともに、互いにラジアル方向Rに対する傾斜角が逆になるチップ側とベース側との間を、滑らかな曲線でつなぎ弓形を形成するようにしている。
【0006】このような従来の完全三次翼では、翼高さの中央部を腹側09に弓状に湾曲させているので、チップ壁面03およびベース壁面04近傍の背側010には、図4に矢視で示すような、これらの壁面03，04に向う押し付け流れ011がそれぞれ発生し、チップ壁面03およびベース壁面04上の圧力を上昇させ、これらの壁面03，04上に発達する、境界層内に発生するクロスフローを低減させることによって、二次流れ損失の低減を図ることはできる。
【0007】しかしながら、このように、チップ壁面03およびベース壁面04近傍の圧力を上昇させることは、これらの壁面03，04近傍から翼高さ方向、いわゆるラジアル方向Rへ圧力勾配が生ずることとなり、この圧力勾配によって、これらの壁面03，04の境界層内に発生する、二次流れのラジアル方向Rへの巻き上がりが増大することとなり、この二次流れの巻き上がりにより、翼01′内を通過する主流05の流れが乱され、流動損失を大きくして、段落効率が低下するという不具合がある。
【0008】
【発明が解決しようとする課題】本発明は、従来の高性能翼、特にチップ壁面およびベース壁面近傍の圧力を上昇させ、これらの壁面上で発達する境界層内で発生するクロスフローを低減させ、二次流れ損失を低減するようにした、従来の完全三次元翼の特性は、そのまま維持するようにするとともに、従来の完全三次元翼で発生する、チップ壁面上およびベース壁面上から翼高さ方向に形成される圧力勾配によって発生する、二次流れの巻き上がりによる効率の低下を防止するため、翼出口部で、このチップ壁面およびベース壁から翼高さ中央部に向け

て形成される圧力勾配の大きさを抑制して、二次流れの巻き上がりを低減することによって、段落効率の低下を少くした高性能翼を提供することを課題とする。

【０００９】

【課題を解決するための手段】このため本発明の高性能翼は、次の手段とした。三次元設計法により、一様流の流れの中で作動する翼のチップ近傍に配設されたチップ壁面、および翼のベース近傍に配設されたベース壁面近傍の圧力を上昇させ、これらの壁面上で発達する境界層内のクロスフローを低減させ、二次流れ損失を低減するようにした、完全三次元翼に製作された高性能翼において、翼プロフィルを、翼入口部が翼高さ中央部で腹側に弓状に湾曲させると共に、翼出口部が、逆に翼高さ中央部で背側に弓状に湾曲させた翼形状にした。

【００１０】本発明の高性能翼は、上述の手段により、従来の完全三次元翼と同様に、翼入口部の腹側への弓状の湾曲により、翼内外径端のチップおよびベース壁面と翼面における境界層内の二次流れを低減し、これらの面から発生する渦の発達をおさえ、翼の後縁から流出する渦の強さを低減して、二次流れ損失を低減することができる。

【００１１】また、これに加えて、翼出口部が翼入口部の弓状の湾曲とは逆の背側へ突出する弓状の湾曲にしたことより、翼入口部で流れを壁面側に押し付け、チップ壁面およびベース壁面から翼高さ中央部に向けて圧力低下が生じていた、ラジアル方向の圧力勾配が、翼入口部から翼出口部にかけて徐々に小さくなり、翼背面での二次流れの半径方向への巻き上がりを低減し、二次流れ損失を低減することとなり、従来の完全三次元翼で発生していた、翼内を通過する主流の乱れが少くなり、段落効率を向上させることができる。

【００１２】

【発明の実施の形態】以下、本発明の高性能翼の実施の一形態を、図面にもとづき説明する。図１は本発明の高性能翼の実施の第１形態を示す図で、翼高さ方向に設ける弓状の湾曲形状を示すための斜視図、図２は図１に示す高性能翼を、チップ壁面とベース壁面との間に配置したものを示すための斜視図である。

【００１３】図１に示すように、翼１の翼入口部２においては、チップ側およびベース側から、徐々に腹４側への突出量を大きくして、翼高さ中央部で腹４側に最も突出させた曲線状の弓状に湾曲した形状が、翼高さ方向に形成されている。すなわち、翼入口部２の最上流端である前縁３においては、ラジアル方向Ｒから、矢視で示す腹４方向に、矢視の長さで示す大きさだけ突出した弓状の湾曲が形成されている。

【００１４】また、翼１の翼出口部６においては、チップ側およびベース側から徐々に背側５へ突出量を大きくして、翼高さ中央部で最大突出量になる曲線状の弓状の湾曲が形成されている。すなわち、翼出口部６の最下流端である後縁７においては、ラジアル方向Ｒから矢視で示す背側５方向に、矢視の長さで示す大きさだけ突出させた弓状の湾曲が形成されている。また、これらの翼高さ方向に設けられる弓状の湾曲は、翼入口部２から翼出口部６に向けても、不連続点のない滑めらかな曲線にされて連ながれている。

【００１５】本発明の高性能翼は、上述のように構成されているので、翼入口部２のラジアル方向に設けた弓状の曲がりによって、翼入口部２においては、図２に示す翼１のチップ側に設けられるチップ壁面８、翼１のベース側に設けられるベース壁面９に向う、図４に示した押し付け流れ０１１と同様の流れが発生し、チップ壁面８上およびベース壁面９上の圧力を上昇させ、これら壁面８，９上で発達する境界層内の二次流れを、これらの圧力上昇で低減し、壁面８，９のそれぞれから発生する渦の発達をおさえ、翼１の後縁７から流出する渦の強さを低減して、二次流れ損失を、従来の完全三次翼と同様に低減することができる。

【００１６】また、翼出口部６が、翼入口部２に形成された弓状の湾曲と逆の、背側５へ凸面を形成した弓状の湾曲にしたことより、翼入口部２で、流れをチップ壁面８、およびベース壁面９側に押し付け、チップ壁面８およびベース壁面９から翼高さ中央部に向けて圧力低下が生じる、ラジアル方向の圧力勾配が、腹側４に突出した弓形の形状から、背側に突出した弓形の形状に変化する、翼入口部２から翼出口部６にかけての弓形の形状の変化により、徐々に小さくなり、翼出口部６では全んどなくなる。このチップ壁面８上、およびベース壁面９上から翼高さ中央部に向けて低減する圧力勾配の消滅により、従来の完全三次元翼で発生していた、翼１背面での二次流れの半径方向への巻き上がりを低減し、二次流れ損失が低減することとなり、従来の完全三次元翼で発生していた、翼内を通過する整流の乱れが少くなり、段落効率を向上させることができる。

【００１７】

【発明の効果】以上説明したように、本発明になる高性能翼によれば特許請求の範囲に示す構成により、従来の三次元設計法により製作された高性能翼を改善した完全三次元翼に比べ、チップ壁面上およびベース壁面上から、それぞれ翼高さ方向へ変化する圧力勾配の発生が抑制され、それに伴う、二次流れの半径方向への巻き上がりも抑制され、この二次流れに起因した流動損失が大巾に低減されて、タービン効率を向上させることができる。

【図面の簡単な説明】

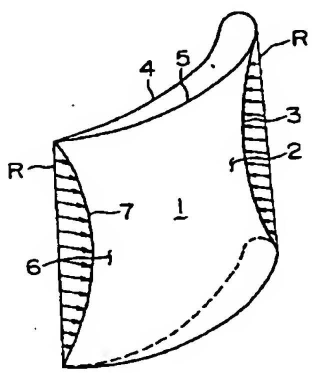
【図１】本発明の高性能翼の実施の第１形態を示す図で、翼高さ方向に設ける弓状の湾曲形状を示すための斜視図、

【図２】図１に示す高性能翼をチップ壁面とベース壁面の間に配置したものを示すための斜視図、

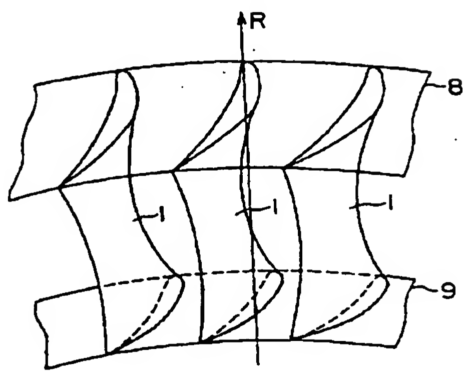
【図３】従来の三次元設計法に製作された高性能翼を軸方向後流側から見た図で、翼後縁の形状と、翼内から流出する流れを示す概念図、
【図４】図３に示す高性能翼を改善した従来の完全三次元翼を軸方向後流側から見た図で、翼後縁の形状と、翼内から流出する流れを示す概念図、
【図５】図４に示す完全三次元翼の斜視図、
【図６】図５に示す完全三次元翼をチップ壁面およびベース壁面の間に配列した部分斜視図である。
【符号の説明】

1 翼
2 翼入口部
3 前縁
4 （翼の）腹
5 （翼の）背
6 翼出口部
7 後縁
8 チップ壁面
9 ベース壁面

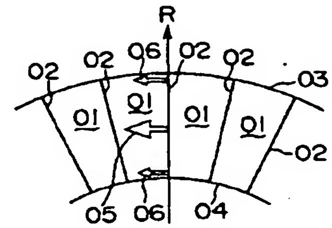
【図１】



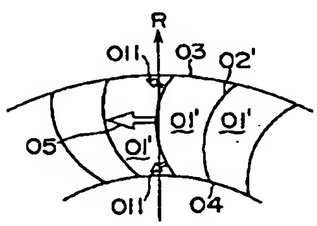
【図２】



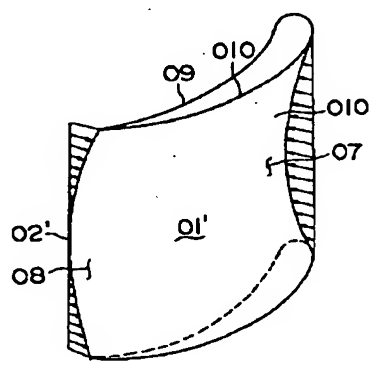
【図３】



【図４】



【図５】



【図６】